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A POSSIBLE ALTERNATE STAGE OF PUCCINIASTRUM MYRTILLI (SCHUM.) ARTH.

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In the East it has been shown that the alternate stage of *Pucciniastrum myrtilli* on various Ericaceous hosts is a *Peridermium* on eastern hemlock, *Tsuga canadensis* L. (1, p. 719; 2, pp. 237–238; 3, p. 27; 4, pp. 33–35). In western Oregon and Washington this rust is reported as very abundant on *Vaccinium macrophyllum* (Hook.) Piper, common on *V. ovalifolium* Smith and *V. caespitosum* Michx., and is rarely encountered on other species such as *V. parvifolium* Smith and *Oxycoccus macrocarpus* (Ait.) Pursh. The writer has found it in this region on only the two species first named. *V. macrophyllum* normally grows at the higher elevations in the mountains, being particularly abundant in the Cascades, where it is commonly and intimately associated with mountain hemlock (*T. mertensiana* (Bong.) Sarg.) and to a lesser extent with western hemlock (*T. heterophylla* (Raf.) Sarg.). While more frequently encountered at lower levels, *V. ovalifolium* is sometimes found with *V. macrophyllum*. In spite of the abundance of *P. myrtilli* on these two huckleberries, no *Peridermium* has ever been found on the hemlocks. The only hemlock rust known in the region is *Caeoma dubium* Ludwig, which is confined to western hemlock. The distribution of this hemlock needle rust as observed over a number of seasons does not indicate a possible connection with *P. myrtilli*.

On May 28, 1924, in Clackamas Co., Oregon, at Government Camp, which is located on the south slope of Mt Hood at an elevation of approximately 4,000 feet, a *Peridermium* (F. P. No. 40402, B. No. 1337)[1] of the cylindrical, columnar type was extremely abundant on the 1923 or previous season's needles of Pacific fir [*Abies amabilis* (Loud.) Forbes]. The current season's, or 1924, needles had not appeared, the buds not yet being open. There was no rust found on western hemlock, mountain hemlock, or noble fir (*A. nobilis* Lind.). *Peridermium ornamentale* Arth. was sparingly present on the needles of alpine fir (*A. lasiocarpa* (Hook.) Nutt.). *Peridermium sp.*, by which the *Peridermium* on silver fir will be designated in this paper, was so abundant that it seemed there should be some clue to

[1] F.P. = Herbarium of the Office of Forest Pathology, Bureau of Plant Industry, U. S. Department of Agriculture. B. = Herbarium of J. S. Boyce. The collections cited in this paper have been examined by Dr. H. S. Jackson.

the alternate host. This was found in the fact that infected silver firs were invariably close to *V. macrophyllum* and that where the huckleberry did not occur there was no *Peridermium sp.*

Further study in this locality was made on July 18. *Peridermium sp.* on silver fir was abundant, although most of the peridia had ruptured and discharged the aeciospores. In the immediate proximity of the infected firs, *P. myrtilli* in the uredinial stage was abundant on *V. macrophyllum* (F. P. No. 40351, B. No. 1341). Owing to absence from the region during the entire growing season of 1925 no observations were made that year, but on May 2, 1926, *Peridermium sp.* was found to be very scarce, a search of two hours yielding only four infected needles. In 1927 conditions were different. While *Peridermium sp.* was not nearly so generally abundant as in 1924, on June 19 it was quite common locally, being closely restricted to the moister localities along the streams and the fringes of small swamps. On August 21 there was a light infection of *P. myrtilli* on the shade forms only of *V. macrophyllum* and *V. ovalifolium*, always within a few feet of heavily infected silver fir.

It has been found that the age of the needles on which the aecia develop is of diagnostic value in the needle rusts of balsam firs. This *Peridermium* is one of the three in the region which appear on needles one year old. In other words, in 1927 the aecia appear on 1926 needles only. One of these, *Uredinopsis macrosperma* (Cooke) Magn., is found commonly on lowland white fir (*A. grandis* Lind.), and its white aecia, which appear in the spring or early summer, are in decided contrast to the orange-yellow aecia of *Peridermium sp.* *Uredinopsis macrosperma* so far has not been found associated with *Peridermium sp.*, but *P. ornamentale* Arth. has been observed each season at Government Camp, confined, however, to alpine fir. While microscopically there is no significant difference between *P. ornamentale* and *Peridermium sp.*, the former produces stout orange-yellow aecia, very much flattened laterally. Furthermore, the two species do not accord in their seasonal frequence. In 1924 when *Peridermium sp.* was so generally abundant, *P. ornamentale* was very scarce. On the other hand, in 1926 when *Peridermium sp.* was so exceptionally scarce, *P. ornamentale* was common, while in 1927 when *Peridermium sp.* was locally abundant, *P. ornamentale* was generally so. From the foregoing it seems that *Peridermium sp.* on silver fir is different from any other *Peridermium* in this region appearing on needles of the same age.

Inoculation experiments have so far failed. On May 2, 1926, at Government Camp, seven plants of *V. macrophyllum* were dug from a spot at an elevation of 4,000 feet where there had been considerable infection of *P. myrtilli* in 1924. These were replanted the same day in a garden at Portland, Oregon, at an elevation of 100 feet. Only two of the plants survived

during the season, both remaining free from rust. The only silver firs in Portland are scattered ornamentals, because the species does not grow naturally at such a low altitude. No silver firs are known in the general neighborhood of this garden, and the nearest forest trees probably are 40 miles away. During the winter another plant died. On June 10, 1927, the one survivor was inoculated with *Peridermium sp.*, brought from Government Camp, by dusting spores from infected sprays on the thoroughly moistened huckleberry leaves. Again on June 19 the operation was repeated with fresh inoculum from the same locality, and in addition a large spray of heavily infected needles was left resting on top of the huckleberry plant and several smaller sprays were left on the ground at its base. The succeeding days were cloudy with intermittent rainfall. No infection resulted from these inoculations, but this was expected since the huckleberry in the garden at an elevation of 100 feet was at least a month older in development than those growing naturally at 4,000 feet at Government Camp. The leaves of the former were dark green in color, tough and leathery, while those of the latter at the same time were light yellow-green in color, soft and succulent. Then, too, the usual lack of vigor in a plant removed to a new environment where soil conditions, particularly acidity, were quite different from its original habitat very probably influenced its reaction to inoculation.

From the foregoing discussion it seems reasonable to conclude that *Peridermium sp.* on needles of the previous season of silver fir on Mt. Hood differs from other Peridermia in this region and that it may be the aecial stage of *Pucciniastrum myrtilli*. This latter possibility is strong enough to warrant inoculation experiments.

This paper is not complete and is based on circumstantial evidence, which in such a complicated group as the needle rusts of balsam firs may be completely misleading, but the information is given with the hope that it may help some future investigator, since the writer can not continue the work.

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